HIDDEN AGENT TRANSFER PROTOCOL

RELATED APPLICATIONS

This application is related to U.S. Application Serial No. __/________, entitled "Universal Protocol for Enabling a Device to Discover and Utilize the Services of Another Device," filed on _______ and assigned to Convergence Corporation, the assignee of the present application.

BACKGROUND

Data transfer protocols are used to facilitate communication between electronic devices by providing a common set of rules by which data may be exchanged between one device and another. A universal protocol could theoretically allow one device to communicate with any other device, from simple devices like the lights in a room to complex devices like personal computers. However, to approach such an ideal, the protocol itself has to be usable with at least a significant proportion of the devices. Different types of devices have different characteristics such as microprocessor abilities, free memory, and accompanying costs. In addition, consumer devices are produced by a wide variety of manufacturers. Coordination and cooperation in interfacing a wide variety of electronic devices is very difficult.

Many times in the past, manufacturers have made attempts to allow consumer level devices to be able to communicate meaningful data or commands to one another. Many protocols define data links between standard small devices. However, this also meant that usually the "standard" became only a standard for that genre of device. Further, while these protocols provide a data link, they do not provide a standard method to allow simple relevant information transfer between two small devices. For example, a typical pager cannot send control information to any particular cellular telephone requesting the cellular telephone to initiate a call to a certain number; a "caller-ID" box is not able to instruct a PDA to display all the contact information for the person who is calling; and a PDA cannot print or fax (without a modem or special drivers).

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~~The inventor of the present invention has developed a protocol and method to facilitate communication between various electronic devices and the sharing of features, functionality and information between these devices which has been described in the invention, U.S. Application Serial No. __/________, entitled, "Universal Protocol for Enabling a Device to Discover and Utilize the Services of Another Device," the entirety of which is incorporated herein by reference. This universal protocol is known as the Service Discovery Transport Protocol ("SDTP").~~

For background information helpful in understanding the present invention, a description of SDTP follows. SDTP is a protocol for facilitating communication between various electronic devices and the sharing of features, functionality and information between these devices. In general, SDTP is a protocol by which one device (the "client device") can discover what services are offered by another device (the "server device"). Utilizing this protocol, the client device can take advantage of the services of the server device. Advantageously, the SDTP is simple enough to be used by nearly any type of electronic device, but at the same time it is robust enough to allow a user to author high-level applications utilizing multiple different services available from multiple devices without requiring the user to have any knowledge of any particular device interface or how the device works. SDTP is capable of use by a wide range of consumer devices allowing them to interact by standardizing many of the normal tasks associated with these devices. SDTP provides a simple data link between these devices.

The operation of SDTP actually begins when the server device sends a message to the client device to inform the client device that it is capable of communicating using the protocol. This message and all subsequent messages may be sent using standard 8-bit ASCII characters. Once the client device determines that the server device is capable of communicating using the protocol, the client device may request the server device to identify what kinds of services the server provides. This request is performed by transmitting a type-command to the server device.

Upon receiving the type-command, the server device responds by transmitting one or more device/service identifiers back to the client device. Each device/service identifier is unique, and represents either a specific device type identification ("ID"), such as a thermostat, a door, a pager, a PDA or many others, or a specific service type identification ("SD"), such as the ability to raise the temperature of the thermostat or to transmit the messages stored in the pager. Finally, the server device transmits a standard ASCII sequence to signal the last of the device/service identifiers.

After the server device identifies itself as being capable of using the protocol, the client device may issue commands to the server device using the unique service identifiers just described. Any necessary parameters may be passed along as well. If everything operates correctly, the service identified by the command is then provided by the server device. Finally, the server device responds to each such command by sending a status code back to the client device. The status code denotes that either: (a) the requested service was unavailable; (b) the server device was unable to complete the operation; (c) the command contained a syntax error; or (d) that the operation completed successfully.

SDTP also supports "learning" new services with which the client is not previously familiar. To invoke this capability, the client device transmits a use-command to the server device to identify the service that the client wishes to learn. Upon receiving the use-command, the server device transmits a service identifier corresponding to the new service and any available parameters. The client device may then invoke the service by sending the service identifier and the requisite parameters.

As the above description of the applicant's SDTP invention shows, attempts have been made in the past to allow various consumer level devices to communicate with one another across a room or perhaps even from room to room within a house; however, there has not been available a method for facilitating communication between consumer devices situated in different locations. For example, there is no protocol for enabling a consumer device at one's home to communicate with a consumer device at one's office. By the same token, there is no protocol for enabling a person's consumer device in a building's conference room facility to communicate with a consumer device in that person's office within the same building.

Therefore, a method is needed to facilitate communications between consumer devices where the consumer devices are located remotely from each other.

In addition, there is a need to extend the Service Discovery Transfer Protocol, disclosed in the above-referenced application, to allow for communications between remotely located consumer devices.

SUMMARY

The present invention is directed towards a system, a protocol and a method for one or more consumer devices at a first location to access the services supplied by one or more consumer devices at a second location. In general, a consumer device at the first location must establish a connection with the a first server at the first location. Next, the first server must establish a network connection with a second server at the second location. Then, the second server at the second location must establish a connection with one of the consumer devices at the second location. In this way, a communications link is formed from a consumer device at a first location to a consumer device at a second location. Next, the consumer device at the first location requests a service to be performed by the consumer device at a second location where the consumer device at the first location communicates with the consumer device at the second location across the established communications link. Lastly, the consumer device at the second location performs the requested service on behalf of the request by the consumer device at the first location.

Therefore, it can be seen that the present invention facilitates communication between remotely located consumer devices by extending the functionality of the Service Discovery Transfer Protocol. These and other aspects, features, and advantages of the present invention will be set forth in the description that follows and possible embodiments thereof, and by reference to the appended drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a system diagram that illustrates an exemplary environment suitable for implementing various embodiments of the present invention.

Fig. 2 illustrates an exemplary environment in which an exemplary embodiment of the HATP protocol operates.

Fig. 3 is an exemplary sequential diagram showing the basic steps of an exemplary embodiment of the present invention.

Fig. 4 is an exemplary state diagram showing the basic operation of an exemplary embodiment of the present invention.

DETAILED DESCRIPTION

Before describing the details of the current invention, some terminology used herein is described. As used in the specification and claims of this invention, consumer devices include, but are not limited to: desktop computers, personal digital assistants (pda's), laptop computers, handheld computers, notebook computers, embedded processor devices, printers, fax machines, scanners, remote control units, X-10™ type electrical control devices, thermostats, electrical outlets, light switches, window controls, garage door systems, whole-house control systems, HVAC systems, security systems and devices, overhead projectors, slide projectors, movie projectors, video cassette recorders and players, compact disk players, DVD players, televisions, stereo systems and components including speakers, clocks, cellular and portable telephones, pagers (one-way and two-way), weather stations, and timekeeping systems. Those skilled in the art will realize that other consumer related devices may also take advantage of this invention and are included within the definition of consumer devices.

The term "protocol" generally refers to a set of formal rules or conventions describing how data is treated in an electronic system. In electronic communications, protocols define the electrical and physical standards to be observed, such as bit-ordering and byte-ordering and the transmission and error detection and correction of the bit messages, the client-server dialog, character sets, and sequencing of messages. Link protocols define the basics of how communication is established and maintained between two devices. Data protocols define how meaningful data is exchanged between the two devices using the link protocol as the underlying communication layer. Unless otherwise indicated, the term "protocol," as used below, refers to the data protocol employed by a given connection between two devices to communicate meaningful data, such as the discovery of information about one device and the issuance of commands by one device to the other.

Referring now to the drawings, in which like numerals represent like elements throughout the several figures, aspects of the present invention and exemplary operating environments and embodiments will be described.

Fig. 1 is a system diagram that illustrates an exemplary environment suitable for implementing various embodiments of the present invention. Fig. 1 and the following discussion provide a general overview of a platform onto which the invention may be integrated or implemented. Although in the context of the exemplary environment the invention will be described as consisting of instructions within a software program being executed by a processing unit, those skilled in the art will understand that portions of the invention, or the entire invention itself, may also be implemented by using hardware components, state machines, or a combination of any of these techniques. In addition, a software program implementing an embodiment of the invention may run as a stand-alone program or as a software module, routine, or function call, operating in conjunction with an operating system, another program, system call, interrupt routine, library routine, or the like. The term program module will be used to refer to software programs, routines, functions, macros, data, data structures, or any set of machine readable instructions or object code, or software instructions that can be compiled into such, and executed by a processing unit.

Those skilled in the art will appreciate that the system illustrated in Fig. 1 may take on many forms and may be directed towards performing a variety of functions within a range of consumer devices, any of which may serve as an exemplary environment for embodiments of the present invention. The invention may also be practiced in a distributed computing environment where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

The exemplary system illustrated in Fig. 1 includes a computing device **10** that is made up of various components including, but not limited to, a processing unit **12**, non-volatile memory **14**, volatile memory **16**, and a system bus **18** that couples the non-volatile memory **14** and volatile memory **16** to the processing unit **12**. The non-volatile memory **14** may include a variety of memory types including, but not limited to, read only memory (ROM), electronically erasable read only memory (EEROM), electronically erasable and programmable read only memory (EEPROM), electronically programmable read only memory (EPROM), electronically alterable read only memory (EAROM), and battery backed random access memory (RAM). The non-volatile memory **14** provides storage for power on and reset routines (bootstrap routines) that are invoked upon applying power or resetting the computing device **10**. In some configurations the non-volatile memory **14** provides the basic input/output system (BIOS) routines that are utilized to perform the transfer of information between the various components of the computing device **10**.

The volatile memory **16** may include a variety of memory types and devices including, but not limited to, random access memory (RAM), dynamic random access memory (DRAM), FLASH memory, EEROM, bubble memory, registers, or the like. The volatile memory **16** provides temporary storage for program modules or data that are being or may be executed by, or are being accessed or modified by the processing unit **12**. In general, the distinction between non-volatile memory **14** and volatile memory **16** is that when power is removed from the computing device **10** and then reapplied, the contents of the non-volatile memory **14** is not lost, whereas the contents of the volatile memory **16** is lost, corrupted, or erased.

The computing device **10** may access one or more internal or external display devices **30** such as a CRT monitor, LCD panel, LED panel, electro-luminescent panel, or other display device, for the purpose of providing information or computing results to a user. The processing unit **12** interfaces to each display device **30** through a video interface **20** coupled to the processing unit over system bus **18**.

The computing device **10** may have access to one or more external storage devices **32** such as a hard disk drive, a magnetic disk drive for the purpose of reading from or writing to a removable disk, and an optical disk drive for the purpose of reading a CD-ROM disk or to read from or write to other optical media, as well as devices for reading from and or writing to other media types including but not limited to, FLASH memory cards, Bernoulli drives, magnetic cassettes, magnetic tapes, or the like. The processing unit **12** interfaces to each storage device **32** through a storage interface **22** coupled to the processing unit **12** over system bus **18**. The storage devices **32** provide non-volatile storage for the computing device **10**.

The computing device **10** may receive input or commands from one or more input devices **34** such as a keyboard, pointing device, mouse, modem, RF or infrared receiver, microphone, joystick, track ball, light pen, game pad, scanner, camera, or the like. The processing unit **12** interfaces to each input device **34** through an input interface **24** coupled to the processing unit **12** over system bus **18**. The input interface may include one or more of a variety of interfaces, including but not limited to, an RS-232 serial port interface or other serial port interface, a parallel port interface, a universal serial bus (USB), an optical interface such as infrared or IrDA, an RF or wireless interface such as Bluetooth, or other interface.

The computing device **10** may send output information, in addition to the display **30**, to one or more output devices **36** such as a speaker, modem, printer, plotter, facsimile machine, RF or infrared transmitter, or any other of a variety of devices that can be controlled by the computing device **10**. The processing unit **12** interfaces to each output device **36** through an output interface **26** coupled to the processing unit **12** over system bus **18**. The output interface may include one or more of a variety of interfaces, including but not limited to, an RS-232 serial port interface or other serial port interface, a parallel port interface, a universal serial bus (USB), an optical interface such as infrared or IrDA, an RF or wireless interface such as Bluetooth, or other interface.

The computing device **10** may operate in a networked environment using logical connections to one or more remote systems, such as a remote computer **38**. The remote computer **38** may be a server, a router, a peer device or other common network node, and typically includes many or all of the components described relative to the computing device **10**. When used in a networking environment, the computing device **10** is connected to the remote system **38** over a network interface **28**. The connection between the remote computer **38** and the network interface **28** depicted in Fig. 1 may include a local area network (LAN), a wide area network (WAN), a telephone connection, or the like. These types of networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.

It will be appreciated that program modules implementing various embodiments of the present invention may be stored in the storage device **32**, the non-volatile memory **14**, the volatile memory **16**, or in a networked environment, in a remote memory storage device of the remote system **38**. The program modules may include an operating system, application programs, other program modules, and program data. The processing unit **12** may access various portions of the program modules in response to the various instructions contained therein, as well as under the direction of events occurring or being received over the input interface **24** and the network interface **28**.

Fig. 2 illustrates an exemplary environment in which an exemplary embodiment of the HATP protocol operates. As shown, the environment comprises a plurality of devices **210 & 240**, represented by circles. As used herein, "devices" include server devices, client devices, client/server devices **210 & 240**. In addition, gateway servers or Hidden Agent Transfer Protocol ("HATP") servers **220-230** are shown. The server devices are capable of providing one or more services or carrying out one or more functions. The client devices are capable of instructing the server devices to carry out a designated function or service via a communications link represented. A service could be an external operation, such as adjusting the temperature of a thermostat or switching the lights in a room on or off, or it might involve additional communication between the server device and the client device, such as sending a telephone number from a PDA to a laptop computer.

As illustrated in Fig. 2, a particular device may be both a server device and a client device such as client/server devices **210 & 240**. The client/server devices **210 & 240** may be capable of instructing other server devices to carry out a designated function while, at the same time, may carry out a function itself. For example, in its client role, a laptop computer might need to retrieve data from a PDA carried by a user, and then in its server role, the laptop might be called on by the user to provide a telephone number directly to a cellular telephone. Thus, the laptop functions as both a client device and a server device. However, in the following description, each device will be discussed only in its role as either a client device or a server device.

As illustrated in Fig. 2, gateway servers or HATP servers **220–230** interface to other HATP servers, client devices, server devices, and client/server devices. HATP facilitates an access point for devices to link across a network (internet/intranets), such that devices remotely scattered across a building, across a city, or across the world appear to each other to be in the same room communicating over the link layer. HATP servers **220-230** act as both clients and servers to other devices. For those local devices wishing to access services from a remote device at a remote location, the HATP server proximate the local device appears to the local device as an SDTP server; whereas, the HATP server proximate the remote device appears to the remote device as an SDTP client. In the exemplary embodiment shown in Fig. 2, a two-way personal pager device **210** requests a first HATP server **220** to connect to a second HATP server **230** in order to use the services available from a security system device **240**. In this instance, the first HATP server **220** acts like an SDTP server device to the personal pager device **210**, and the second HATP server **230** appears to security system device **240** to be an SDTP client device.

HATP servers thus act as a gateway between remotely located SDTP devices. The HATP server implements two different protocols: when interfacing to SDTP devices, HATP servers utilize a HATP extension to the standard SDTP protocol described in the co-filed U.S. Application Serial No. __/________, entitled, "Universal Protocol for Enabling a Device to Discover and Utilize the Services of Another Device;" and when interfacing to another HATP server, the HATP server utilizes the HATP protocol. Both the HATP extension to the SDTP protocol, and the HATP protocol are described in this specification.

A HATP server **220-230** typically resides on a personal computer and communicates with SDTP devices over the standard link layer. The HATP servers **220-230** communicate with each other over the Internet or over an intranet using TCP/IP protocol, also known as the network link. Of course, those skilled in the art will realize that other network protocols could be used to link one or more HATP servers **220-230** to each other.

As stated above, when connected to a device, a HATP server "looks" like a standard SDTP device implementation. When a device connects to a HATP server, it will export services like an SDTP server. At least one service will be the HATP service. The HATP server has the following services available which serve as an extension of the SDTP protocol. Table 1 below outlines these services and their associated parameters.

Device	Device ID	Service	Service ID	Parameters
HATP Server	XYZ-HATP			
		Connect to another HATP server	XYZ-CONNECT	<network address> <userid> <password>
		Disconnect	XYZ-DISCONNECT	

Table 1

The local HATP server will reply to the local SDTP device with one of the following responses from Table 2:

Device	Device ID	Service ID	Response	Comments
HATP Server	XYZ - HATP			
		XYZ - CONNECT	XYZ - NOSERV	A connection to the server could not be established.
			XYZ - NOUSER	The user/password combination is not authentic.
			XYZ - OK	The connection is established.
			XYZ - ALREADY	A connection is already established with another server.
		XYZ - DISCONNECT	XYZ - DISCONNECT	

Table 2

The HATP protocol comprises at least three HATP commands that may be issued between HATP servers once a network link connection is established. One such command is the XYZ-USER command whereby the local HATP server requests the remote HATP server to verify that a user identification sent by the local SDTP device is valid. Another command is the XYZ-PWD command by which the local HATP server verifies from the remote HATP server that the password sent by the local SDTP device is valid for that user identification. Another command is the XYZ-TYPE command which requests the remote HATP server to return a list of ID's and SD's of SDTP devices with which the remote HATP server is in communication. Table 3 below illustrates these HATP commands and parameters.

Device	Device ID	Service	Service ID	Parameters
HATP Server	XYZ-HATP			
		Transfer the User ID	XYZ-USER	<userid>
		Transfer the password	XYZ-PASSWORD	<password>
		Get a list of IDs and services	XYZ-TYPE	

Table 3

The responses sent by the remote HATP server from requests by the local server are listed in Table 4 below.

Device	Device ID	Service ID	RESPONSE	COMMENTS
HATP Server	XYZ-HATP	XYZ-USER	XYZ-OK	<userid> is in the database of users
			XYZ-NOUSER	<userid> is not in the database of users
		XYZ-PASSWORD	XYZ-OK	<password> is valid for that <userid>
			XYZ-INVLDPW	<password> is invalid for that <userid>
		XYZ-TYPE		Returns a list of ID's and SD's in communication with the remote HATP server.

Table 4

Fig. 3 is an exemplary sequential diagram illustrating the basic steps of an exemplary embodiment of the present invention. It is important to note that this diagram is meant to depict only the basic functionality of the protocol and that actual use of the protocol will commonly involve a greater or lesser number of steps. Further, it is important to note that the steps shown and described do not all have to take place in the sequence shown. The sequence represents only a typical use of the available protocol functions which may or may not be followed in actual use.

As shown in Fig. 3, use of the protocol of the present invention does not begin until communication between a client **210** and a HATP server **220** is already established at Step **300** using a link protocol, also referred to as a link layer. The protocol of the present invention does not require the use of a specific link layer, but in an exemplary embodiment, the protocol may impose certain requirements such as: 1) allowing for serial ASCII data transfer; and 2) if binary data is to be sent, using standard UUEncode/UUDecode routines to provide the proper conversions to and from ASCII data. Existing link layers which meet these requirements include, but are not limited to, serial cable, IrDA, Bluetooth and TCP/IP sockets.

If a device provides a service, it must be running a protocol server. Once a connection **300** using the link layer is complete, the HATP server **220** will identify itself as being capable of communicating using the protocol of the present invention by issuing a tag line message **302**. The issuance of the tag line message **302** signals the actual start of the operation of the protocol of the present invention. In an exemplary embodiment, the tag line message **302** and all subsequent messages are sent using standard 8-bit ASCII characters. In the illustrated embodiment, the tag line message **302** is in the following format:

PROTOCOLNAME VER:N.N [COMMENTS].

where PROTOCOLNAME is the name of the protocol, N.N is the current version of that protocol, and COMMENTS is an optional field which can be used to describe the manufacturer, the date of manufacture, or the like. As previously mentioned in referenced U.S. Application, Serial No. __/_______, Convergence Corporation has developed a universal protocol, called Service Discovery Transport Protocol ("SDTP") which embodies many of the aspects of this invention. Thus, in the example shown in Fig. 3, the SDTP-enabled server transmits the following tag line message:

SDTP VER:1.0 Conv. Corp. 1998.

Further description of the protocol of the present invention will focus on this specific, exemplary embodiment, but it should be understood that the present invention is not limited to the specifics of the SDTP protocol.

Once the HATP server **220** issues the tag line message **302**, the client **210** may request the HATP server **220** to identify the device types it supports and the services the HATP server **220** provides. This request is performed by transmitting a type-command **304** to the HATP server **220**. The type-command could be implemented in a variety of forms, but in the illustrated embodiment, the type-command **304** comprises the word "TYPE." Although it is common for the client to send the type-command **304**, it should be understood that sending the type-command is not a required step. For example, a client may already be aware that a particular service is available from the server. Advantageously, this may save time in the communication process.

If the HATP server **220** receives the type-command **304**, the HATP server **220** transmits to the client **210** a data packet **306-312** describing the devices and services provided by the HATP server **220**. The data packet **306-312** contains several data fields. Among the data fields are one or more device/service identifiers **306-310**, each of which represents either a specific device type or a specific service type. For example a device type may include a thermostat, a door, a pager, a PDA or the like. A service type may include the ability to raise the temperature of a thermostat or to transmit the messages stored in a pager. In the preferred embodiment illustrated in Fig. 2 & Fig. 3, the device is a HATP server where the device/service identifier subsists in the following form:

$x_1x_2x_3$-NAME

where NAME may be a short (7 characters or less) description of the device or the service, and $x_1x_2x_3$ is a unique three character "identifier." Each of the three characters of the three character identifier is chosen from an alphabet consisting of the characters:

[0..9], [a..z], and [A..Z].

In addition, the x_1, x_2 and x_3 characters are chosen such that

$$(x_1 * x_2) + x_3$$

forms a unique value. This technique allows for 12161 unique device/services to be used under SDTP and HATP while at the same time only requiring 16-bit math to be used when describing a device or a service. Thus, the data packet

306-312 sent by the server device must include at least one device identifier **306**. In the example shown in Fig. 3, the device identifier is $X_{1A}X_{2A}X_{3A}$-HATP. In addition, because HATP servers support a variety of services, the device identifier **306** is followed by multiple service identifiers **308-310**. In the example shown in Fig. 3, the service identifiers are $X_{1B}X_{2B}X_{3B}$-CONNECT **308** and $X_{1C}X_{2C}X_{3C}$-DISCONNECT **310**.

In an exemplary embodiment, each individual device/service identifier **306-310** is sent as a single line of data and is limited to a maximum of 64 characters in length. Advantageously, this technique allows devices having a limited amount of RAM to receive and process a full line of data without facing an overflow condition. The end of a line of data is signaled by transmitting the ASCII carriage return and line feed characters. Upon transmission of the final device/service identifier **306-310** by the HATP server, the end of the response is signaled by transmitting an end of response message **312**. In an exemplary embodiment, an end of response message **312** includes the ASCII characters .<CR><LF>. Thus, the basic structure of a HATP server data packet sent in response to a type-command would be as follows:

ID: $X_{1A}X_{2A}X_{3A}$-HATP <cr><lf>

SD: $X_{1B}X_{2B}X_{3B}$-CONNECT <cr><lf>

SD: $X_{1C}X_{2C}X_{3C}$-DISCONNECT <cr><lf>

.<cr><lf>

Once the HATP server **220** has established a link with the client **210**, in the exemplary embodiment a pager, the pager may issue commands to the HATP server **220**. The CONNECT service request **314** is sent from the client **210** to the HATP server followed by the required parameters. The purpose of the CONNECT service is to request the local HATP server **220** to connect to a remote HATP server **230**; therefore, the parameters required for the CONNECT service include the network address of the remote HATP server **230** to which the client **210** wishes to become connected, the user ID of the client **210**, and the password of the client **210**. The CONNECT request **314** consists of the CONNECT command followed by IP address 100.100.100.100, user identification "BOB", and password "0444."

Once the HATP server **220** receives the client's CONNECT request **314**, the HATP server **220** uses the appropriate protocol, TCP/IP or another protocol, to form a network link connection **332** with the remote HATP server **230**. When the network link connection **332** is established between the two HATP servers **220 and 230**, the HATP server **230** at the remote location, shown as an office PC, sends forth to the HATP server **210** at home a tag line message **334**. In an exemplary embodiment, the tag line message **334** and all subsequent messages are sent using standard 8-bit ASCII characters. In the illustrated embodiment, the tag line message **334** is in the following format:

PROTOCOLNAME VER:N.N [COMMENTS].

where PROTOCOLNAME is the name of the protocol, N.N is the current version of that protocol, and COMMENTS is an optional field which can be used to describe the manufacturer, the date of manufacture, or the like. Thus, in the example shown in Fig. 3, the HATP server **230** transmits the following tag line message:

HATP VER:1.0 Conv. Corp. 1998.

The HATP server **220** will next send the user command **336** to the HATP server **230**. In this case, the USER command **336** includes the parameter "BOB" because this is the user name that client **210** sent as the user ID parameter of its connect command **314**. HATP server **230** will check its database of registered user ID's to ensure that "BOB" is a registered user identification. In this example, "BOB" is a registered user identification, so the HATP server **230** responds to HATP server **220** by issuing the OK response **338**. The HATP server **220** will then send the password command (PWD) **340** to the HATP server **230**. The parameter following the password command **340** is the password which the SDTP client sent as a parameter with its connect command **314** to the HATP server **220**. The HATP server **230** will check this password against that stored within its internal database as the appropriate password for BOB and, if this password is correct, will respond with OK **342**. The HATP server **220** upon receiving the OK **342** response from the HATP server **230** will then initiate an OK response **344** to the client **210**. This OK response allows the client **210** to verify the connection was made between the two HATP servers **220 and 230**.

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From this time until a DISCONNECT command is sent from the client **210** to its local HATP server **220**, all remote SDTP devices which have an established link layer with the remote HATP server (a) will appear to the local SDTP device to be located locally and (b) will respond to any service requests initiated from the local SDTP device. In the exemplary embodiment of Fig. 2 and Fig. 3, a security system **240** is remotely located at the site of the remote HATP server **230**. At some earlier point in time, the security system **240** established a link **316** with the HATP server **230**. The HATP server **230** issued a TYPE command **320** to the security system **240**. The security system **240** responded with its ID and services **322-330**. In this example, the response consisted of the following services STAT **324**, ON **326**, and OFF **328**. While this example, for illustration, shows only a single SDTP device, multiple SDTP devices could have established links with the HATP server **230**.

While not required for the local client to access services from the remote server or servers, a local client will usually initiate a TYPE command **346** to interrogate the services available to the local client through the remote HATP server **230**. When the local HATP server **220** receives the SDTP TYPE command **346**, it sends the HATP TYPE command **348** to the remote HATP server. The remote HATP server **230** will respond with its own ID and associated services **350**, **354**, **358**, as well as all ID's and services **230, 362**, **366**, **370**, **374 and**, **378** for SDTP devices in communication over the link layer **316** with the remote HATP server. As the local HATP server **220** receives these responses to the HATP TYPE command **348** from the remote HATP server **230**, the local HATP server **220** passes these responses on to the client **210** by transmission of the various commands **352**, **356**, **360**, **364**, **368**, **372**, **376**, and **380**.

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At this point, the local client device **210**, in the illustrated embodiment a two-way pager, may seek to access services from the remote server device **230**. For example, the local client device **210** may issue the STAT command **382** to seek the status of the alarm system at the office. The local HATP server **230** will relay this command to the remote HATP server **230** by issuing the STAT command 384 which will in turn relay this service to the remote server **240** by issuing the STAT command **386**. The remote server device, security system, will determine its status, in this case ARMED, and send this information back to the remote HATP server **220** by replying with the response ARMED **388**. The remote HATP server **230** will forward the armed response **390** to the local HATP server **220** which will in turn respond to the local client **210** with the ARMED response **392**. Through the mechanism described above, a local client device can access services from a remote server device.

Fig. 4 is a useful state diagram of the operation of a typical HATP server running the HATP extended SDTP protocol and the HATP protocol. Upon powerup, the HATP server enters a READY state **400**. From this READY state **400**, several events may trigger action by the HATP server. If an SDTP device establishes a link layer with the HATP server and a new link is established **405**, the HATP server will issue the TYPE command **410** to inventory the services available from the SDTP devices linked to the HATP server. If the SDTP devices are server or client/server devices, they will respond to the TYPE command **410** with a TYPE response **420** consisting of their ID's and SD's (available services). The HATP server will store this inventory of available services in a database for future reference and return to the READY state **400**. If the new SDTP devices are only client devices, there will be no response **415** from the new client devices, and the HATP server will return to its READY state **400**.

Sub a5 Also from READY state **400**, the HATP server may receive a TYPE command **425** from any SDTP devices that have established a link layer with the HATP server. The HATP server would then respond with its own ID of HATP and a listing of its available services: CONNECT & DISCONNECT.

From READY state **400**, the HATP server may receive a link layer CONNECT request **435** from an SDTP device. The HATP server will verify **440** that the user identification and password are valid for the remote HATP server with which the SDTP device requests the connection to be made. If the user identification/password combination is not valid or if a connection with another remote HATP server has already been established, the connection will fail **445** and the HATP server will return to its READY state **400**. If the user identification/password combination is valid and there is not a connection already established, the HATP server will change to its CONNECTED AS LOCAL state **450**.

From the CONNECTED AS LOCAL state **450**, the HATP server acts as a local gateway through a remote HATP server to remote SDTP servers. If the HATP server receives a TYPE command **452** from the local SDTP device, the HATP server will query the remote HATP server for a listing of ID's and SD's available from remote SDTP devices. It will then respond **454** with this listing to the local SDTP device that issued the query and return to the CONNECTED AS LOCAL **450** state.

From the CONNECTED AS LOCAL state **450**, the HATP server may receive a service request **456** from the local SDTP device to access a service found at a remote SDTP device. The HATP server will pass this service request **458** to the remote HATP server, and await response **460**. After the response is received at the local HATP server, the local HATP server will reply to the client **462** by relaying the response received from the remote HATP server and then return to the CONNECT **450** state..

The HATP server may also receive a DISCONNECT command **464** from the local SDTP device after which it will disconnect **466** from the remote HATP server and return to READY state **400**.

From READY state **400**, the HATP server may receive a network layer CONNECT request **468** from another HATP server. The HATP server will verify **470** that the user identification and password is valid. If the user identification/password combination is not valid or if a connection with another HATP server has already been established, the connection will fail **472** and the HATP server will return to its READY state **400**. If the user identification /password combination is valid and there is not a connection already established, the HATP server will change to its CONNECTED AS REMOTE state **474**.

From CONNECTED AS REMOTE state **474**, the HATP server acts as a remote gateway from which a local HATP server will access remote SDTP servers. If the HATP server receives a TYPE command **476** from the local HATP server, it will then respond **478** to the local HATP server that issued the query with a listing of ID's and SD's available from remote server devices and return to the CONNECTED AS REMOTE **474** state.

From CONNECTED AS REMOTE state **474**, the HATP server may receive a service request **480** from the local HATP server to access a service found at a remote SDTP device. The HATP server will pass this service request **482** to the remote SDTP server, and await response **484**. After the response is received at the HATP server, the remote HATP server will reply to the local HATP server **486** by relaying the response received from the remote SDTP server.

The HATP server may also receive a DISCONNECT command **488** from the local HATP server after which it will disconnect **490** from the local HATP server and return to READY state **400**.

From the foregoing description, it will be appreciated that the present invention provides a system, a protocol and a method for facilitating communication between various remotely located, consumer devices and enabling the consumer devices to share features, functionality and information. Although the present invention has been described using various examples and command formats, it will be appreciated that the present invention is not limited by these examples.

The present invention may be implemented and embodied in a variety of devices and may be implemented in software or hardware. In addition, the operation, steps and procedures of the present invention may be implemented in a variety of programming languages. The specification and the drawings provide an ample description of the operation, steps and procedures of the present invention to enable one of ordinary skill in the art to implement the various aspects of the present invention.

The present invention has been described in detail with particular reference to exemplary embodiments. It is understood that variations and modifications can be effected within the spirit and scope of the invention, as described herein before, and as defined in the appended claims. The corresponding structures, materials, acts, and equivalents of all means or step plus function elements in the claims below are intended to include any structure, material, or acts for performing the functions in combination with other claimed elements as specifically claimed.